



Distillers Grain Industry: Production, Use, Structure and Trends

Jeri Stroade
Anikka Martin
Ann Conrad
Kansas State University
jstroade@ksu.edu

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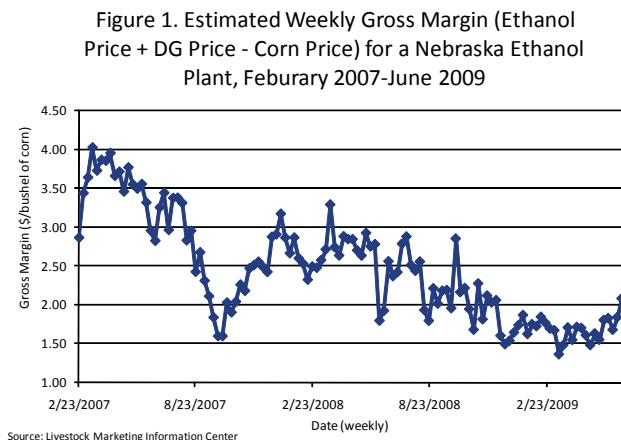
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Background and Purpose

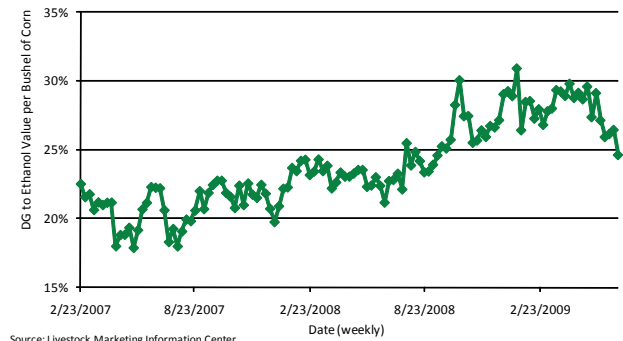
As the ethanol industry has expanded in recent years, distillers grain (DG) production has gained importance both as an output for ethanol producers and as an input for livestock producers. As figure 1 illustrates, margins for ethanol plants have tightened considerably since 2007. Estimated gross margin for ethanol plants per bushel of corn declined from a high of \$4.03 in March 2007 down to less than \$1.50 in late 2008 and early 2009 and back to \$2.08 in June 2009. Gross margin is the value of ethanol plus the value of distillers grain produced per bushel of corn less the price of corn per bushel. Decline in ethanol value is responsible for most of this tightening margin. These difficult economic conditions have elevated the importance of DG value in ethanol producer profitability.



As ethanol margins have tightened, DG value has increased relative to ethanol value. As figure 2 shows, the value of distillers grain produced from one bushel of corn was 23% of the value of ethanol produced from one bushel of corn in February 2007. This figure dropped to a low of 18% in May 2007 and rose to a high of 31% in January 2009. In June 2009, DG value was 25% of ethanol value. In general, from 2007 to 2009 DG gained value relative to ethanol. Both the narrowing of margins in the ethanol industry and this increase in DG value relative to ethanol value emphasize the need for a sound understanding of DG's role in the ethanol industry.

In a similar manner, the growing use of DG in the livestock industry has increased their importance to livestock producers. The increasing significance

Figure 2. Value of DG Relative to Ethanol per Bushel of Corn for a Nebraska Ethanol Plant, February 2007-June 2009



of distillers grain to both the ethanol and livestock industries elevates the need to better understand the distillers grain industry and associated issues. The purpose of this factsheet is to overview the distillers grain industry and highlight factors affecting its future. This factsheet, which is the beginning of a series exploring aspects of distillers grain market development, price discovery, and risk management, includes an overview of distillers grain production, market structure, and consumption.

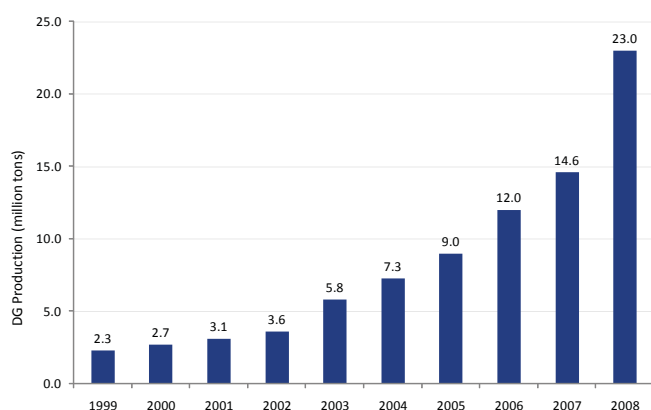
Industry Volume & Growth

The ethanol industry has experienced rapid growth in recent years. Ethanol production expanded from 1.5 billion gallons in 1999 to 9 billion gallons in 2008. Distillers grain production during the same period increased from 2.3 million metric tons to 23 million metric tons. Figure 3 shows the ten-fold increase in DG production over the past ten years. In 2008 DG production increased 57% over the previous year. In 2007, just less than 25% of the corn crop was used for ethanol production whereas, 30% of the crop was used for ethanol in 2008.

Distillers Grain Production Process

Ethanol in the United States is primarily produced from corn using either a dry milling or wet milling process. Dry milling produces co-products of distillers grain (DG) and condensed distillers solubles. Feedstocks besides corn (i.e. sorghum) can also be used to produce ethanol. Dry milling plants are more common because

Figure 3. Distillers Grain Production 1999-2008



Source: Renewable Fuels Association

they are lower cost to build and operate compared to wet milling plants. Distillers grains are sold as dried (10% moisture), modified wet (50-55% moisture), or wet distillers grain (65-70% moisture). On average, a bushel of corn with 56 pound test weight produces 2.8 gallons of ethanol, 18 pounds of dried distillers grain with solubles, and 18 pounds of carbon dioxide. Ethanol plants generate approximately 6 pounds of distillers grain for every gallon of ethanol produced. Figure 4 illustrates how distillers grain is produced in a dry milling process. First, the feedstock (corn and/or sorghum) is ground into a fine flour or meal. The meal is then soaked in water and enzymes, which break down the starch into simple sugars as the mixture is heated. Ammonia is also added to control pH and act as a nutrient for the yeast (added later). This mixture, or mash, is heated to activate the enzymes and to control bacteria during the fermentation process. After the starch is broken down, the mash undergoes fermentation in which yeast is added to convert the sugar to alcohol. As the yeast feeds on the sugars and produces alcohol, it emits carbon dioxide. The carbon dioxide is removed from the fermentation tanks with a CO₂ scrubber.

After the carbon dioxide is removed, the products of fermentation (alcohol, water and solids) are transferred to distillation columns where the alcohol is purified. In the distillation columns, the solid part of the mixture is pumped out of the bottom where it settles. These solids are distillers grains. As they are pumped from

the bottom of the distillation column, the water and alcohol are heated to 170 degrees which causes the alcohol to evaporate. The alcohol is collected in its gaseous form and transferred to a second distillation column. This heating and purifying is repeated several times in a series of columns until enough water is removed to result in 190 proof alcohol. In order to purify the alcohol further, it is run through a molecular sieve to separate the water molecules from the alcohol molecules. Since alcohol molecules are larger than water molecules, the sieve (porcelain balls filled with tiny beads) absorbs the water molecules, but not the alcohol molecules. The product that comes out of the molecular sieve is 200 proof alcohol or ethanol. The ethanol is then denatured, stored and shipped to market.

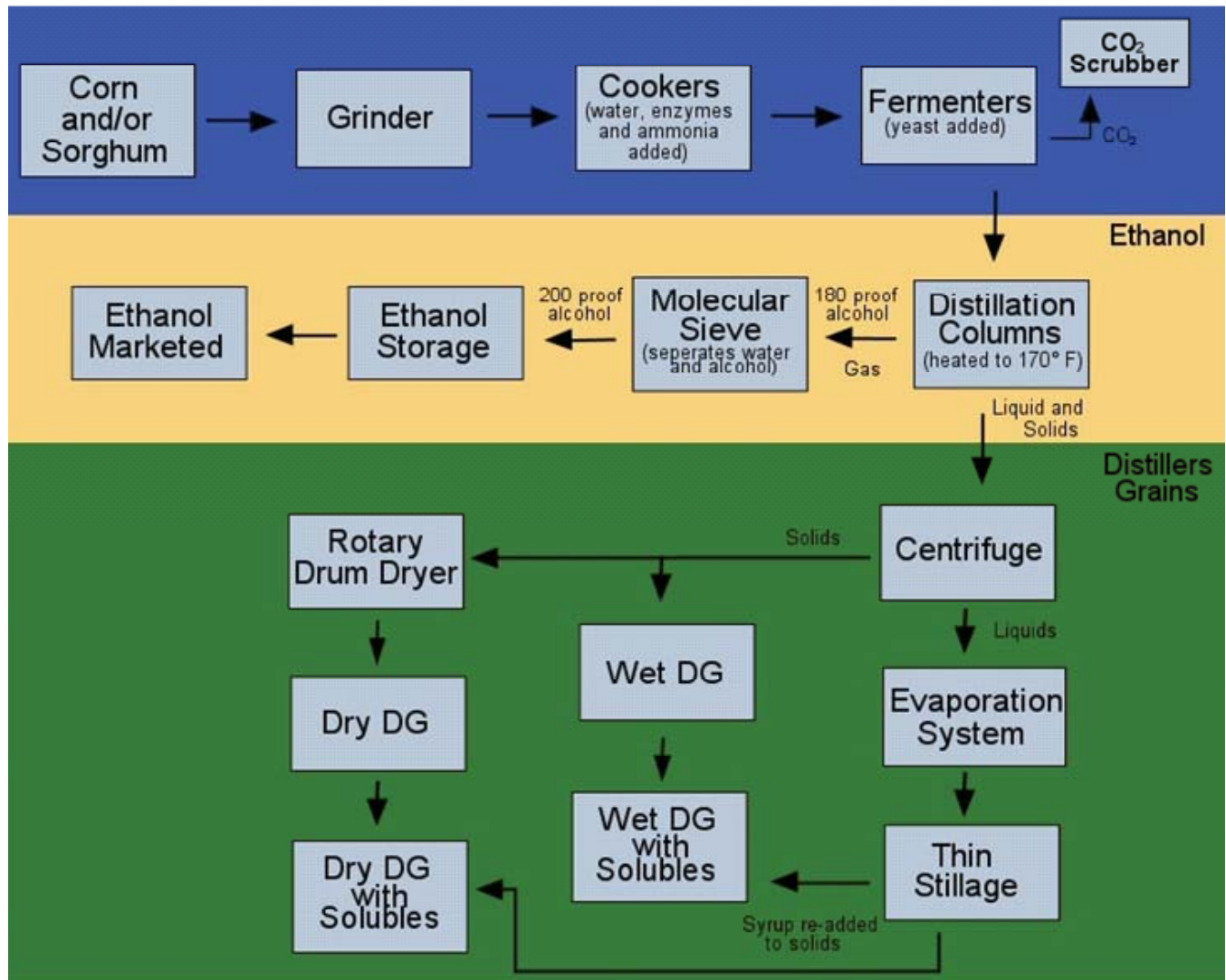
After the distillers grain solids are pumped from the distillation column, they are run through a centrifuge to separate the liquid from the solids. The solids from the centrifuge are wet distillers grains having about 65% moisture. This product is either marketed as wet DG or dried and marketed as dried DG. The water from the liquid that was separated by the centrifuge is evaporated producing a thickened syrup with high nutritional value for livestock. This syrup is added back into the final (wet or dry) DG product to produce distillers grains with solubles.

Distillers Grain Production Locations

Since distillers grains are a co-product of ethanol production, DG production is primarily located near ethanol bio-refineries. Table 1 shows ethanol production by state as of June 2009. Iowa ethanol plants represent the largest percentage of the market at 29%. Illinois plants represent the second largest capacity at 11%. The top four ethanol producing states generate 60% of total

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Figure 4. Dry Mill Ethanol and Distillers Grain Production Process



ethanol production while the top ten producing states represent 87% of ethanol production.

As of July 2009, 173 ethanol plants were operating in the United States. Figure 5 shows the ethanol plants that are currently operating, those that are idled and those under construction as of January 2009. As can be seen from the map, the concentration of currently operating ethanol plants is the highest in Iowa, Southern Minnesota and Eastern South Dakota. Also, while ethanol plant expansion is concentrated in the Midwest, 28% of new capacity is being added in other areas of the US. The major corn producing states of Illinois, Iowa, and Nebraska contain the largest amount of expansion in the ethanol industry based on the capacity of plants under construction. In total these states contain 58% of the new production capacity.

New construction will add 14% to the current production capacity. As of July 2009, 23 ethanol plants were idle, almost all of them because of difficult economic conditions. Sixteen of these 23 plants were either in bankruptcy or have been purchased from a bankrupt company and have yet to start operations. These 23 plants account for approximately 13% of current production capacity, which has been idled.

Market Share

Due to recent volatility in the ethanol industry, market shares have changed considerably over the last year and will continue to evolve. Table 2 compares the estimated market share of the largest ten ethanol refineries in 2009 with their market share in 2008. The ten largest ethanol firms account for 48% of the total

Table 1. Ethanol Production by State, June 2009

Rank	State	Ethanol Production Capacity (Million Gallons/Year)	Share of Total Capacity (%)	Cumulative Share of Capacity (%)
1	Iowa	3,176.0	29.4%	29.4%
2	Illinois	1,183.0	11.0%	40.4%
3	Nebraska	1,161.0	10.8%	51.1%
4	South Dakota	906.0	8.4%	59.5%
5	Minnesota	837.6	7.8%	67.3%
6	Indiana	706.0	6.5%	73.8%
7	Wisconsin	498.0	4.6%	78.4%
8	Kansas	411.5	3.8%	82.2%
9	Missouri	261.0	2.4%	84.7%
10	Ohio	246.0	2.3%	86.9%
11	North Dakota	233.0	2.2%	89.1%
12	Michigan	215.0	2.0%	91.1%
13	Tennessee	167.0	1.5%	92.6%
14	Texas	140.0	1.3%	93.9%
15	Colorado	125.0	1.2%	95.1%
16	Georgia	100.4	0.9%	96.0%
17	Arizona	55.0	0.5%	96.5%
18	Mississippi	54.0	0.5%	97.0%
19	New York	50.0	0.5%	97.5%
20	Oregon	40.0	0.4%	97.9%
21	California	39.5	0.4%	98.2%
22	Kentucky	35.4	0.3%	98.5%
23	New Mexico	30.0	0.3%	98.8%
24	Wyoming	6.5	0.1%	98.9%
25	Idaho	4.0	0.0%	98.9%
26	Louisiana	1.5	0.0%	98.9%
	All Others	115.0	1.1%	100.0%
	United States Total	10,797.4	100.0%	

Source: Nebraska Energy Office

Figure 5. US Ethanol Biorefinery Locations, January 2009



Table 2. Market Shares Based on Capacity of 10 Largest Ethanol Biorefineries, July 2009

Rank	Firm	Market Share as of July 2008	Market Share as of July 2009	Cumulative Share as of July 2009
1	POET Biorefining	13.0%	13.3%	13.3%
2	Archer Daniels Midland	11.7%	9.7%	23.0%
3	Valero Renewable Fuels	N/A	7.1%	30.0%
4	Green Plains Renewable Energy	1.1%	4.3%	34.4%
5	Hawkeye Renewables, LLC	2.3%	4.0%	38.4%
6	The Andersons Ethanol, LLC	2.9%	2.5%	40.9%
7	BioFuel Energy, LLC	N/A	2.1%	42.9%
8	Aventine Renewable Energy, LLC	2.2%	1.9%	44.8%
9	Glacial Lakes Energy, LLC	2.2%	1.9%	46.7%
10	Advanced Bioenergy, LLC	1.1%	1.6%	48.3%

Source: Calculated from data obtained from Renewable Fuels Association & Nebraska Energy Office

Table 3. Operations Feeding Ethanol Co-Products, 2007

	Feeding Co-Products	Not Feeding Co-Products but Considering Feeding Them	Not Feeding Co-Products and Not Considering
	(% of respondents)		
Dairy Cattle	38	22	40
Beef Cattle	36	34	30
Cattle on Feed	13	30	57
Hogs	12	35	53

Source: USDA, NASS, Ethanol Co-Products Used for Livestock Feed

production of ethanol in the United States as of July 2009. The largest firm, POET Biorefining, has 13% of the market share followed by Archer Daniels Midland (ADM) with 10% market share. Valero Renewable Fuels holds the third largest market share with 7%. As table 2 shows, Valero Renewable Fuels did not hold any of the top ten market shares in 2008. However, when VeraSun Energy Corporation, who held 7% of the market, declared bankruptcy in late 2008, Valero Renewable Fuels purchased several of their plants. These purchases gave Valero Renewable Fuels 7% of the market and the third largest spot among ethanol biorefineries.

Distillers Grain Consumers

Currently the main consumers of ethanol co-products are beef, dairy, swine, and poultry. The estimated market value of feed distillers grain in 2007-2008 was \$3 billion (RFA). A 2007 USDA survey of 9,400 livestock operations in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin identified the number of operations feeding ethanol co-products. Table 3 summarizes co-product use by survey respondents. Figure 6 depicts the domestic user distribution of distillers grain consumption during 2007 as reported by the 2008 Yearbook of the Renewable Fuels Association. Beef and dairy cattle each represent 42% of consumption for a total of 84% of North American DG consumption. Swine and poultry consume far

less distillers grain representing 11% and 5% of total consumption, respectively.

Export markets for distillers grain continue to expand, increasing 91% between 2007 and 2008 (RFA).

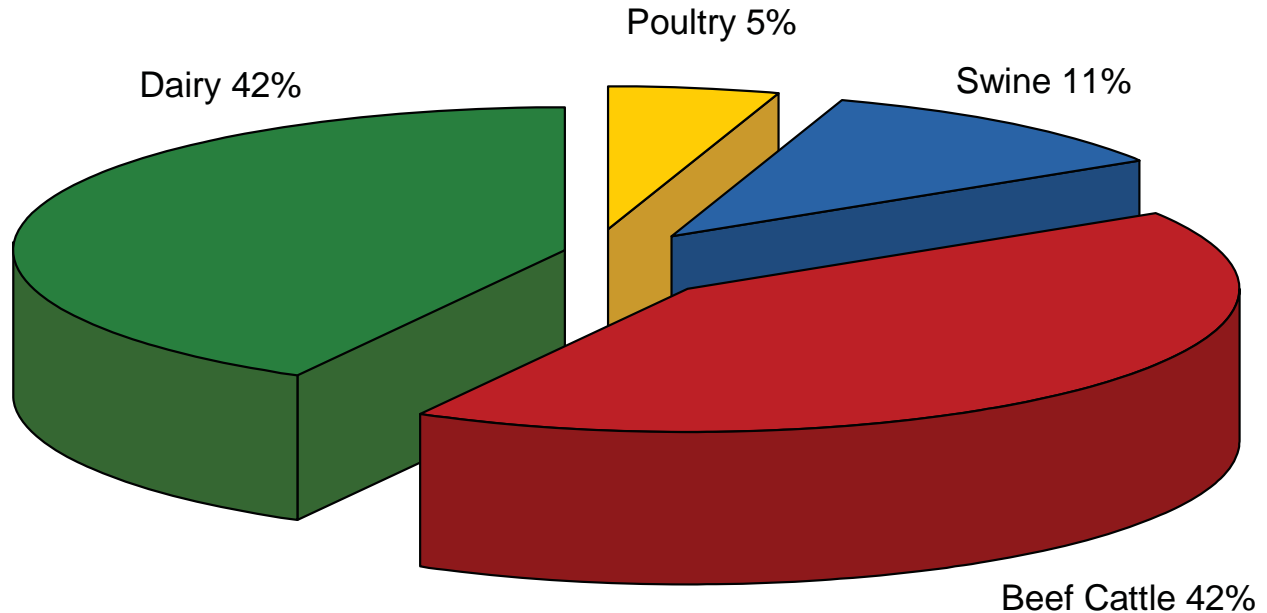
Distillers grain exports totaled 4.51 million metric tons in 2008, roughly 20% of total distillers grains production. The top three foreign markets for DG in 2008 were Mexico, Canada, and Turkey, respectively.

Industry Growth

Economic and regulatory conditions have afforded rapid expansion for the ethanol industry in recent years. Specifically, blending requirements established by the Renewable Fuel Standards Act, high crude oil prices, an ethanol blending credit, and the tariff on ethanol imports combined to make the industry attractive to new entrants. However, within the last year margins in the industry have narrowed considerably. Since the summer of 2008, high corn prices along with lower oil, and subsequently, ethanol prices have

The difficult market conditions have forced companies out of business resulting in a significant amount of production capacity being idled and plants changing hands within the last year. This is leading to a consolidation of the industry as well as oil companies buying ethanol plants at a discount.

Figure 6. North American Distillers Grain Consumers, 2007



Source: Renewable Fuels Association

decreased ethanol margins. Further, the blender's credit was reduced from \$0.51 per gallon to \$0.45 per gallon of ethanol in January 2009.

These factors have made survival in the ethanol industry more difficult and caused shifts in industry structure. The difficult market conditions have forced companies out of business resulting in a significant amount of production capacity being idled and plants changing hands within the last year. This is leading to a consolidation of the industry as well as oil companies buying ethanol plants at a discount.

The rapid expansion in capacity for ethanol production has led to concern over reaching a "blend wall" for gasoline blended with 10% ethanol. If ethanol production reaches the blend wall, the point at which ethanol production equals 10% of the nation's gasoline, the domestic demand for ethanol will be exhausted. The Environmental Protection Agency (EPA) estimates that the blend wall will be reached by 2013. At an ethanol blend rate of 10%, the blend wall in 2013 would be 14.5 billion gallons of ethanol. This figure will vary based on E10 distribution and gasoline use. If ethanol cannot be distributed nationwide or if gasoline use declines, the blend wall will be reached before 2013. The EPA is currently considering raising

ethanol blending allowances to 15% which would ease concerns over reaching the blend wall and provide additional domestic outlets for ethanol supply. The EPA's decision will affect the ethanol industry significantly. If the blending allowance is raised, domestic demand will have expansion potential. If the allowance is not raised, increases in domestic demand will depend on an increase in flex-fuel vehicle demand or on technological innovations that will find new uses for ethanol.

Another factor affecting the industry's future is policy. On May 5, 2009, President Obama issued a biofuels directive highlighting the importance of biofuels as a tool to lessen dependence on foreign oil, insulate consumers from oil price shocks, create jobs and tax revenue, as well as the importance of research and development for utilizing a variety of non-grain feedstocks to create ethanol. The current administration's decisions regarding ethanol will impact the industry's future. Ethanol is required as an oxygenate for gasoline and there are government subsidies and mandates for ethanol fuel production which means this will contribute to the demand for ethanol increasing in years to come.

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